



SMERFS and SMERFS³

Tools for Software Reliability Assessment

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Goddard Space Flight Center NASA

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PURPOSE

To provide an overview to the Workshop attendees of the software reliability tools that are available for reliability assessment.



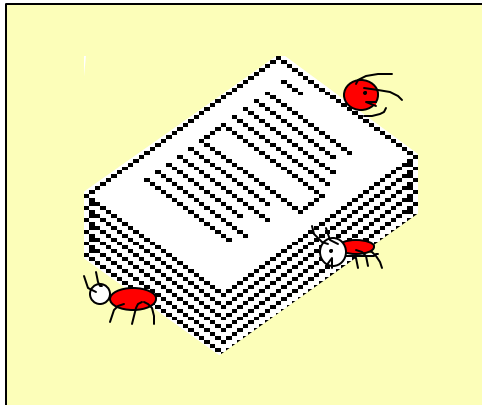
Outline of Presentation

- Overview of Software Reliability
- History of **SMERFS** and **SMERFS^3**
- Current & Future Direction
- How to obtain copies.

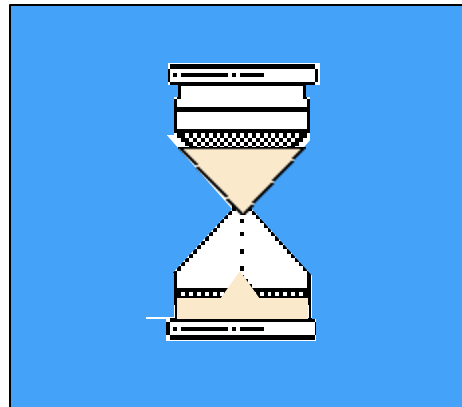


QUESTIONS ADDRESSED BY SOFTWARE RELIABILITY MODELING

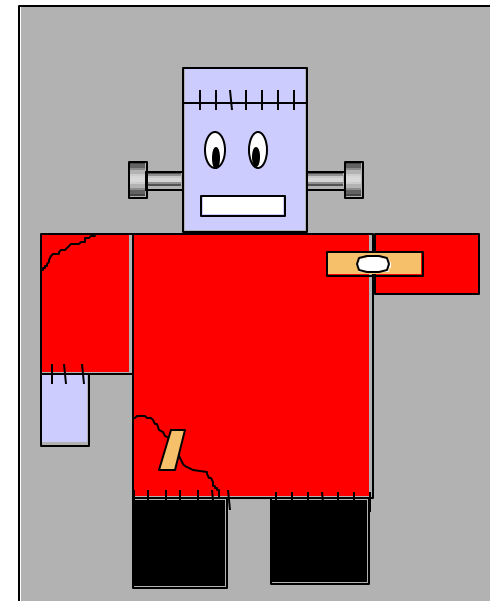
**HOW ERROR FREE IS THE
SOFTWARE?**



WHEN SHOULD I STOP TESTING?

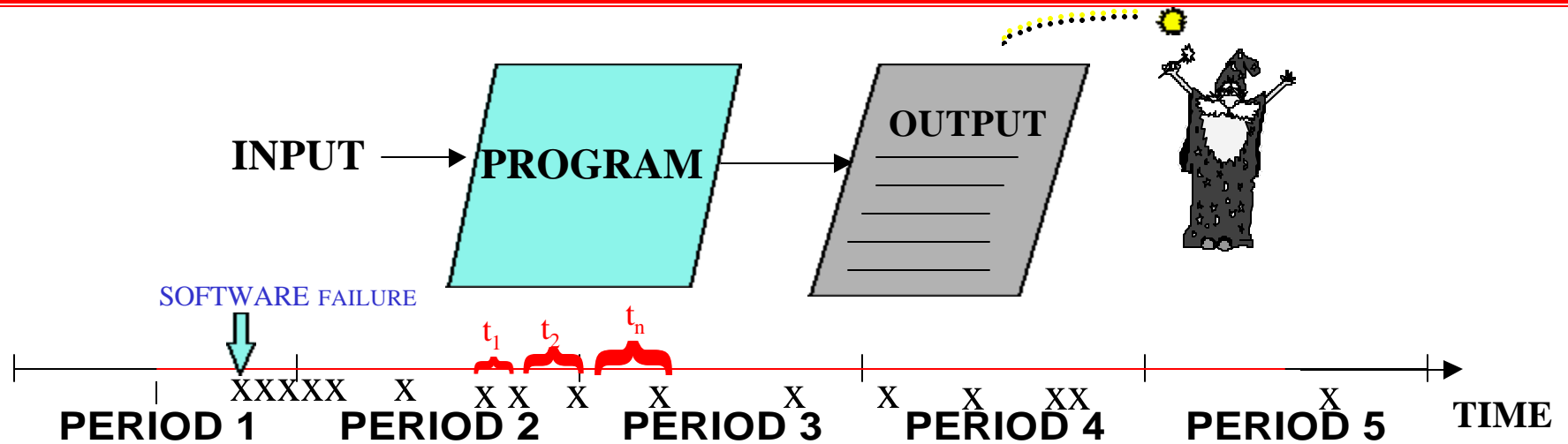


**SHOULD THE PROGRAM BE
REENGINEERED?**





APPROACH TO ESTIMATING S/W RELIABILITY IN THE TIME DOMAIN



SOFTWARE RELIABILITY DATA:

NUMBER OF FAILURES/PERIOD (e.g.,
6,4,2,3,1,...)

OR

TIME BETWEEN FAILURES (e.g., t_1 , t_2 , ... t_n)



SOFTWARE RELIABILITY MEASURES

ERROR COUNT MODELS

- TOTAL NUMBER OF ERRORS
- EXPECTED NUMBER OF ERRORS IN FUTURE TESTING PERIODS
- FAILURE RATE
- TESTING TIME REQUIRED TO ELIMINATE THE NEXT K ERRORS OR TO ACHIEVE A SPECIFIED FAILURE RATE
- CURRENT PROGRAM RELIABILITY

TIME BETWEEN MODELS

- TOTAL NUMBER OF ERRORS
- MEAN TIME TO NEXT FAILURE
- FAILURE RATE
- TESTING TIME REQUIRED TO ACHIEVE A SPECIFIED RATE
- CURRENT PROGRAM RELIABILITY



ORGANIZATION OBJECTIVES

**TO ENSURE THE HIGHEST QUALITY IN
THE DELIVERED PRODUCTS TO THE
NAVY THROUGH:**

- A. Verification and Validation,**
- B. Quality Control, and**
- C. Configuration Management**

**THROUGHOUT THE LIFECYCLE OF
THE PRODUCTS.**



SOFTWARE RELIABILITY MODELING AT NSWCDD

- SLBM Software Development program initiated research in 1981
 - Investigated “software reliability modeling” approaches
 - Developed a useful reliability tool for QA (SMERFS)
 - Applied software reliability methodology on the Trident I (C4) and Trident II (D5) systems
- Engineering of Complex Systems (ECS)
 - Sponsored by the Office of Naval Research.
 - One particular task was to develop methodologies and their implementations for the evaluation and assessment of “complex” systems.
 - Development of **SMERFS³** (**S**tatistical **M**odeling and **E**stimation of **R**eliability **F**unctions for **S**ystems: **S**oftware, **H**ardware, and **S**ystems)



SMERFS and **SMERFS³**
(1982 – 1996) (1996 – present)

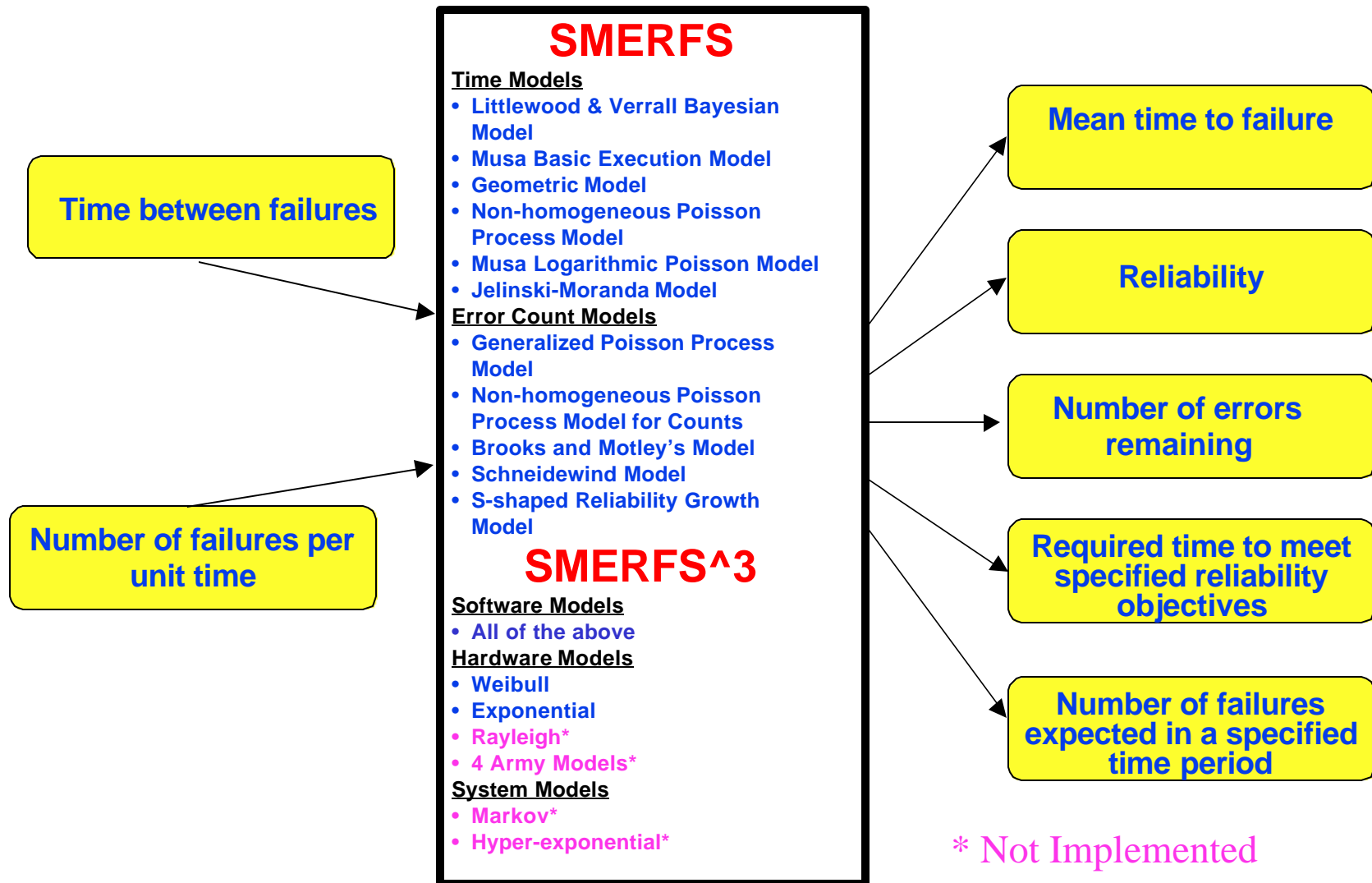
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S YSTEMS³

(**H**ARDWARE, **S**OFTWARE,
& **S**YSTEMS)



SMERFS and SMERFS³





SMERFS³

- **FOR A PC WINDOWS ENVIRONMENT (WINDOWS, NT)**
- **INCORPORATES HARDWARE, SOFTWARE, AND SYSTEM'S RELIABILITY (SOFTWARE + HARDWARE)**
- **CAPTURES ALL OF THE FUNCTIONALITY OF **SMERFS****
- **GUI INTERFACE - (VISUAL C++)**
- **LIBRARY IN FORTRAN 90**
- **HARDWARE MODELS: EXPONENTIAL, RALEIGH, WEIBULL, CONTINUOUS AND DISCRETE RELIABILITY GROWTH PROJECTION MODELS, AND THE CONTINUOUS AND DISCRETE RELIABILITY TRACKING MODELS**
- **SYSTEM MODELS: HYPEREXPONENTIAL AND MARKOV MODELS**
- **INCORPORATED INTO ARMY'S **INSIGHT** TOOL**



Current & Future Efforts

- **ARMY**
 - Last year and this year we had an initiative to incorporate **SMERFS^3** into the Army's **Insight** tool.
 - **Insight** is a tool developed by the Army's Software Metrics Office that helps the user tailor and implement the issue-driven software and systems measurement process as defined in the DOD's *Practical Software and Systems Measurement (PSM) Guide*.
(Discussion by Scott Lucero)
- **Jet Propulsion Laboratory (JPL), Naval Postgraduate School (NPS), and the Air Force Operational Test and Evaluation Center (AFOTEC)**
 - Develop a new **SMERFS^3** incorporating software, hardware, and systems as well as integrating in JPL's **CASRE** tool
 - Additional features will include: early reliability prediction and new models
 - Currently seeking funding and developing a series of papers/presentations showing the benefits of reliability assessment



HOW TO OBTAIN COPIES

- Contact me:
 - By Phone: (540) 653-8388
 - By Email: farrwh@nswc.navy.mil
- Indicate **SMERFS** or **SMERFS^3**
- Selected copy will be emailed as a zipped file